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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Revision of Part 22 of the	)	CC Docket No. 92-115
Commission's rules governing	)	
the Public Mobile Services	)	

REPLY COMMMENTS OF COMP COMM, INC.

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November 5, 1992

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Revision of Part 22 of the Commission's rules governing the Public Mobile Services	)	CC Docket No. 92-115

REPLY COMMENTS OF COMP COMM, INC.

Comp Comm, Inc. ("Comp Comm") hereby submits its Reply Comments in the Revision of Part 22 of the Commission's rules governing the Public Mobile Services, CC Docket No. 92-115,

SUMMARY

These reply comments focus on providing an engineering analysis of the proposed formulas for calculating service and interference contour distances. New formulas are proposed for the various services. Formulas are also proposed for 931 MHz Paging to replace the tables.

TABLE OF CONTENTS

Subpart E-Paging and Radio Telephone Service

ONE-WAY PAGING OPERATION

VHF Paging.

Comp Comm has completed its in-depth study of the proposed equations for calculating VHF Paging Service and Interference Contour distances. The results of this analysis are contained in the following attached series of Figures:

- Figure A1 gives the proposed VHF Paging Service Contour Equation.
- Figure A2 plots the results of the proposed equation.
- Figure A3 plots the Carey 43 dBu reference data used to develop this equation.
- Figure A4 plots the differences between the equation and the underlying Carey reference data.
- Figure A5 contains basic data and an analysis of how well the equation fits the reference data.
- Figure A6 gives the proposed VHF Paging Interference Contour Equation.
- Figure A7 plots the results of the proposed equation.
- Figure A8 plots the Carey reference data used to develop this equation. Only the Carey data without the 3 dB/octave height correction for heights above 500' is plotted.
- Figure A9 plots the differences between the equation and the underlying Carey reference data for heights up to 500'.
- Figure A10 plots the proposed formula along with the Carey reference data points both with and without the 3 dB/octave height correction for heights above 500'.
- Figure A11 contains basic data and an analysis of how well the equation fits the reference data.

Figures A5 and A11 also contain information about how well the FCC's proposed equation fits the Carey reference data. As can be seen from a study of these attachments, the equations being proposed by Comp Comm provide a better fit to the underlying Carey reference data. It is essential that the equations provide a reasonable fit for Carey data across the full range of applicable heights and powers; the fit should not be limited just to lower values that typically occur in the majority of situations.

Comp Comm proposes that the FCC's proposed equations for VHF Paging Service and Interference Contour distances be replaced by the equations defined herein.

931 MHz Paging.

Comp Comm's Comments proposed that the 931 MHz tables be replaced by equations for calculating the service and interference contour distances. The service curves are to be used to determine a height-power limit for perimeter sites by requiring that the average contour distance in the basic eight radial directions not exceed 32 km (20 mi). It should be noted that the proposal defined the service and interference contour distances of all perimeter sites to be 32/80 km; this was done so as to retain the current 112 km (70 mi) fixed separation distance for allocation purposes. Use of equations for service and interference contours permit interior "fill-in" facilities to be designed in a very easy manner. All the problems inherent in the existing and proposed tables disappear.

In order to develop the necessary equations, the engineering information filed in Telocator's Comments in CC Docket No. 88-135, RM-5555 was utilized. This was the same engineering information that was used to construct the present tables.

Attached hereto are a series of Figures that give the service and interference equations:

- Figure B1 gives the proposed 931 MHz Service Contour Equation.
- Figure B2 plots the results of the proposed equation.
- Figure B3 plots the 'Okumura' reference data used to define the present tables.
- Figure B4 plots the differences between the equation and the underlying Okumura reference data.

- Figure B5 contains basic data and an analysis of how well the equation fits the reference data.

- Figure B6 gives the proposed 931 MHz Interference Contour Equation.

- Figure B7 plots the results of the proposed equation.

- Figure B8 plots the 'Okumura' reference data used to define the present tables.

- Figure B9 plots the differences between the equation and the underlying Okumura reference data.

- Figure B10 contains basic data and an analysis of how well the equation fits the reference data.

Comp Comm's Comments contained extensive proposed language utilizing these equations. This proposed text will not be repeated here. Comp Comm proposes that the 931 MHz equations contained herein along with the rule proposals contained in our Comments be adopted.

ONE-WAY OR TWO-WAY MOBILE OPERATION

VHF

Comp Comm has completed its in-depth study of the proposed equations for calculating VHF One-Way or Two-way Mobile Service and Interference Contour distances. The results of this analysis are contained in the following attached series of Figures:

- Figure C1 gives the proposed VHF One-Way or Two-Way Mobile Service Contour Equation.
- Figure C2 plots the results of the proposed equation.
- Figure C3 plots the Carey 37 dBu reference data used to develop this equation.
- Figure C4 plots the differences between the equation and the underlying Carey reference data.
- Figure C5 contains basic data and an analysis of how well the equation fits the reference data.
- Figure C6 gives the proposed VHF One-Way or Two-Way Mobile Interference Contour Equations.
- Figure C7 plots the results of the proposed equation.
- Figure C8 plots the Carey reference data used to develop this equation. Only the Carey data without the 3 dB/octave height correction for heights above 500' is plotted.
- Figure C9 plots the Carey reference data with the 3 dB/Octave height correction included for heights above 500'.
- Figure C10 plots a 50/50 weighted average of the Carey reference contour data with and without the 3 dB/octave height correction above 500'.
- Figure C11 plots the differences between the equation and the underlying Carey reference data for heights up to 500'.
- Figure C12 plots the FCC's proposed equations. These plots are included to illustrate the discontinuity contained in the FCC's proposed equations.

- Figure C13 contains basic data and an analysis of how well the equations fits the reference data.

Figure C5 also contains information about how well the FCC's proposed equation fits the Carey reference data. Figure C13 does not contain information about the fit of the FCC's proposed Interference equation due to the discontinuities illustrated in the various plots in Figure C12. It is our belief that equations that have discontinuities are unsuitable. As can be seen from a study of these attachments, the equations being proposed by Comp Comm provide a better fit to the underlying Carey reference data. It is essential that the equations provide a reasonable fit for Carey data across the full range of applicable heights and powers; the fit should not be limited just to lower values that typically occur in the majority of situations.

Comp Comm proposes that the FCC's proposed equations for VHF One-Way or Two-Way Mobile Service and Interference Contour distances be replaced by the equations defined herein.

UHF

Comp Comm has completed its in-depth study of the proposed equations for calculating UHF One-Way or Two-way Mobile Service and Interference Contour distances. The results of this analysis are contained in the following attached series of Figures:

- Figure D1 gives the proposed UHF One-Way or Two-Way Mobile Service Contour Equation.
- Figure D2 plots the results of the proposed equation.
- Figure D3 plots the Carey 39 dBu reference data used to develop this equation.
- Figure D4 plots the differences between the equation and the underlying Carey reference data.
- Figure D5 contains basic data and an analysis of how well the equation fits the reference data.
- Figure D6 gives the proposed UHF One-Way or Two-Way Mobile Interference Contour Equations.
- Figure D7 plots the results of the proposed equation.
- Figure D8 plots the Carey reference data used to develop this equation. Only the Carey data without the 3 dB/octave height correction for heights above 500' is plotted.
- Figure D9 plots the Carey reference data with the 3 dB/Octave height correction included for heights above 500'.
- Figure D10 plots a 50/50 weighted average of the Carey reference contour data with and without the 3 dB/octave height correction above 500'.
- Figure D11 plots the differences between the equation and the underlying Carey reference data for heights up to 500'.
- Figure D12 contains basic data and an analysis of how well the equations fits the reference data.

Figures D5 and D12 also contain information about how well the FCC's proposed equations fits the Carey reference data. As can be seen from a study of these attachments, the equations being proposed by Comp Comm provide a better fit to the underlying Carey reference data. It is essential that the equations provide a reasonable fit for Carey data across the full range of applicable heights and powers; the fit should not be limited just to lower values that typically occur in the majority of situations.

Comp Comm proposes that the FCC's proposed equations for UHF One-Way or Two-Way Mobile Service and Interference Contour distances be replaced by the equations defined herein.

CONCLUSION

These Reply Comments present extensive engineering analysis of the various proposed equations. Revised equations that provide better fits to the underlying Carey Service and Interference Contours are proposed. Also, Service and Interference Contour equations are developed and presented for 931 MHz Paging facilities.

Figure A1. Proposed VHF Paging Service Contour Formula.

The following formula has been developed for calculating VHF Paging Service Contour Distances:

$$d = 1.302 \times h^{(0.393-0.0000087 \times p)} \times p^{(0.207-0.0000213 \times h)}$$

where
- d is the radial distance in kilometers
- h is the radial antenna HAAT in meters
- p is the radial ERP in watts

Figure A2 contains a series of plots of the proposed formula.

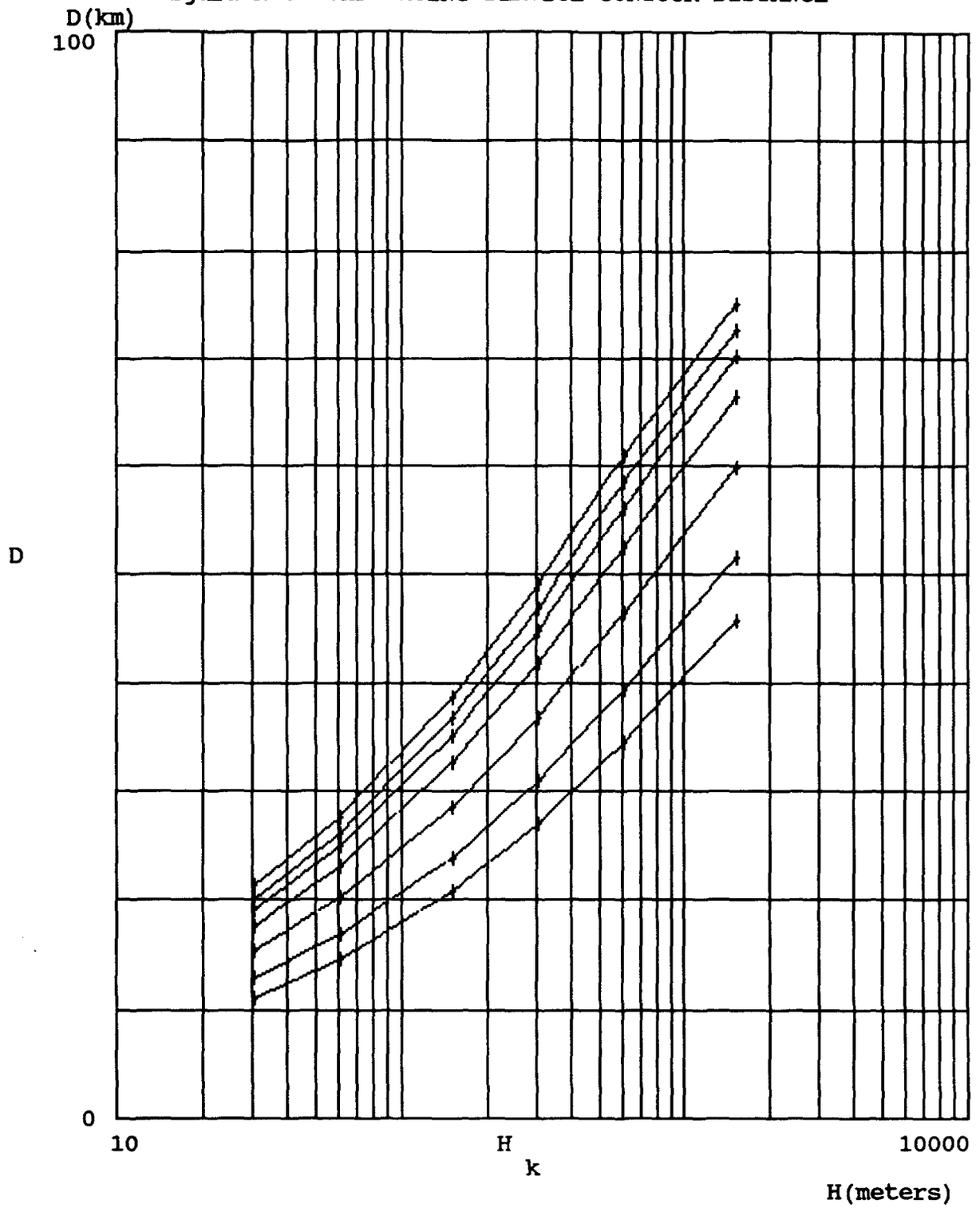
Figure A3 contains a series of plots of the Carey 43 dBu Service Contour Distances for the same points displayed in Figure A2.

Figure A4 contains a series of plots of the differences between the proposed formula results and the Carey Service Contour data.

Figure A5 contains listings of the Carey 43 dBu Service Contour data, errors, and relevant results. Errors for the FCC Proposed equation are also listed. The equation used for these calculations was:

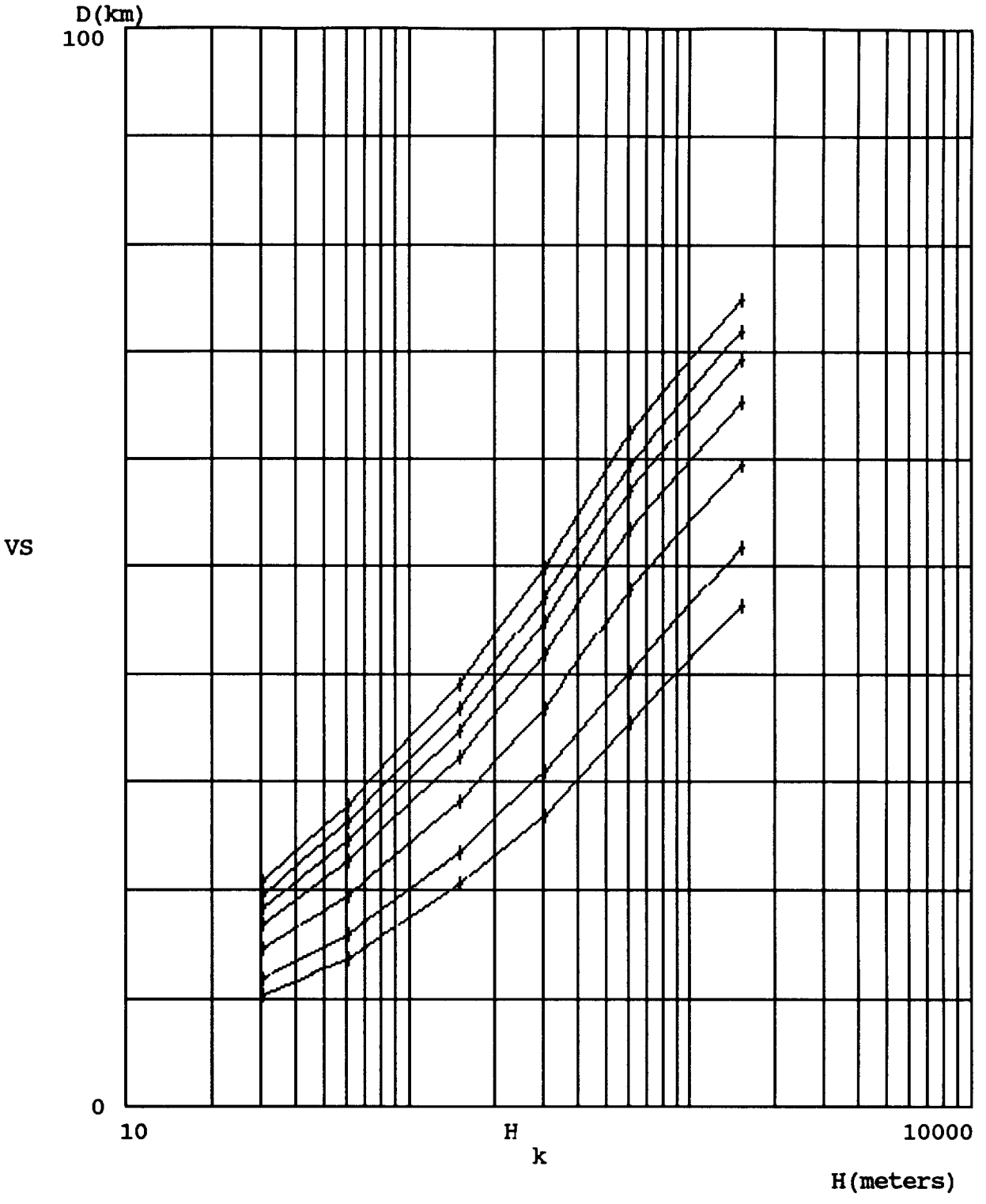
$$d = 1.169 \times h^{0.40} \times p^{0.21}$$

Figura A2. VHF PAGING SERVICE CONTOUR DISTANCE



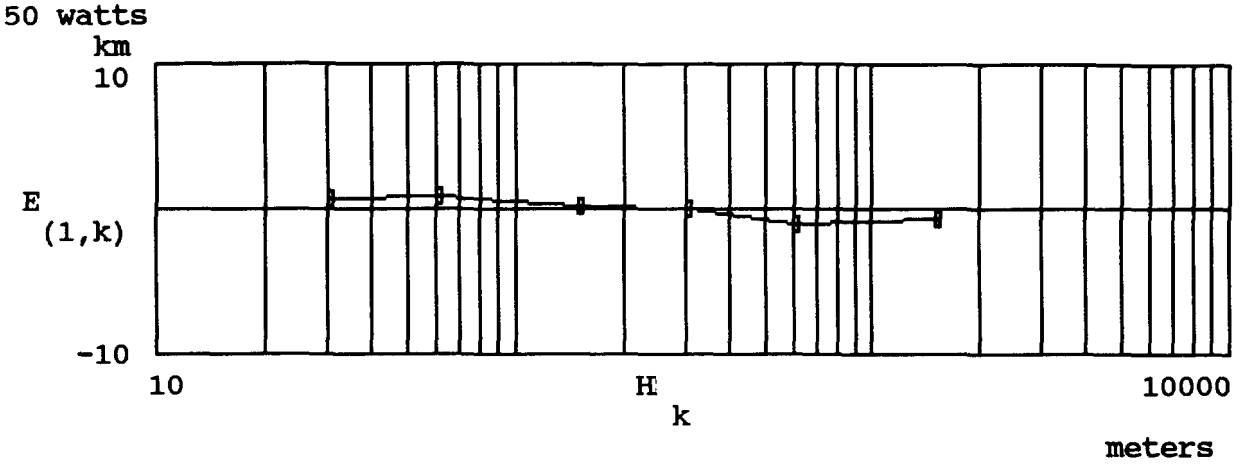
VHF Paging Service Contour Distances as calculated from proposed formula as a function of Height for ERP's of 50, 100, 250, 500, 750, 1000, 1400 watts.

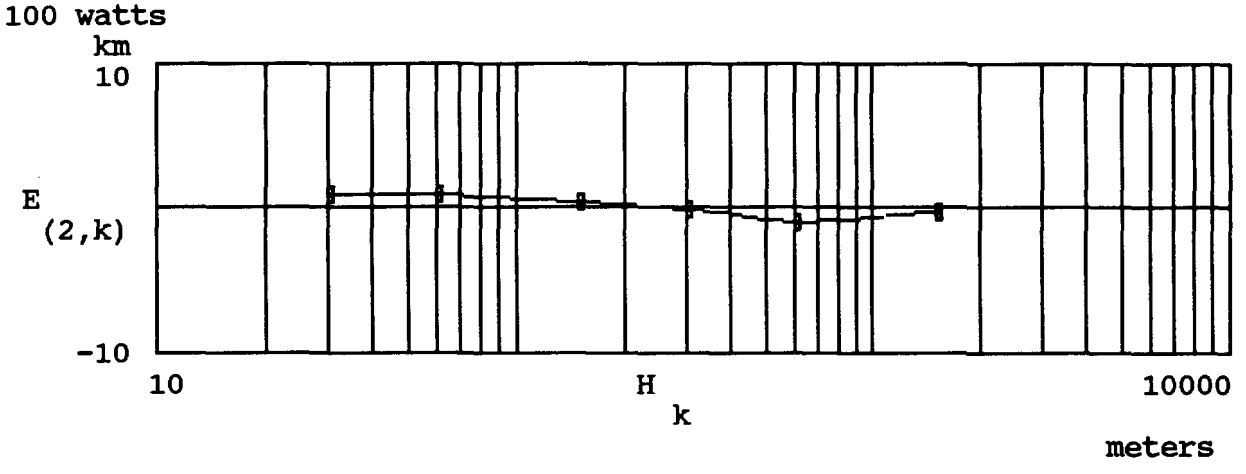
Figure A3. VHF PAGING 43 dBu Service Contour Distances

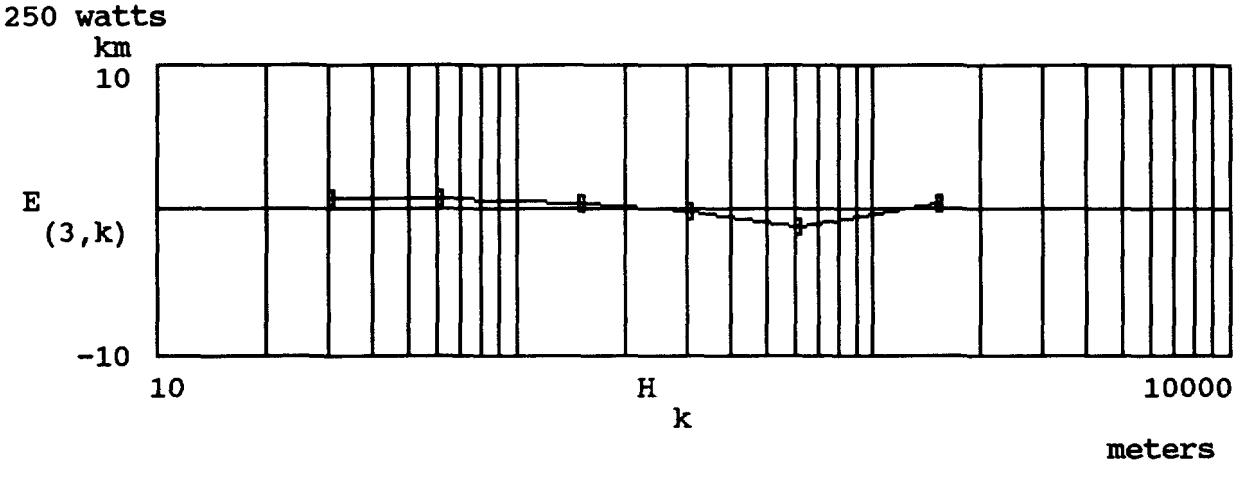


VHF Paging Carey 43 dBu Service Contour Distances
as a function of Height for ERP's of
50, 100, 250, 500, 750, 1000, 1400 watts.

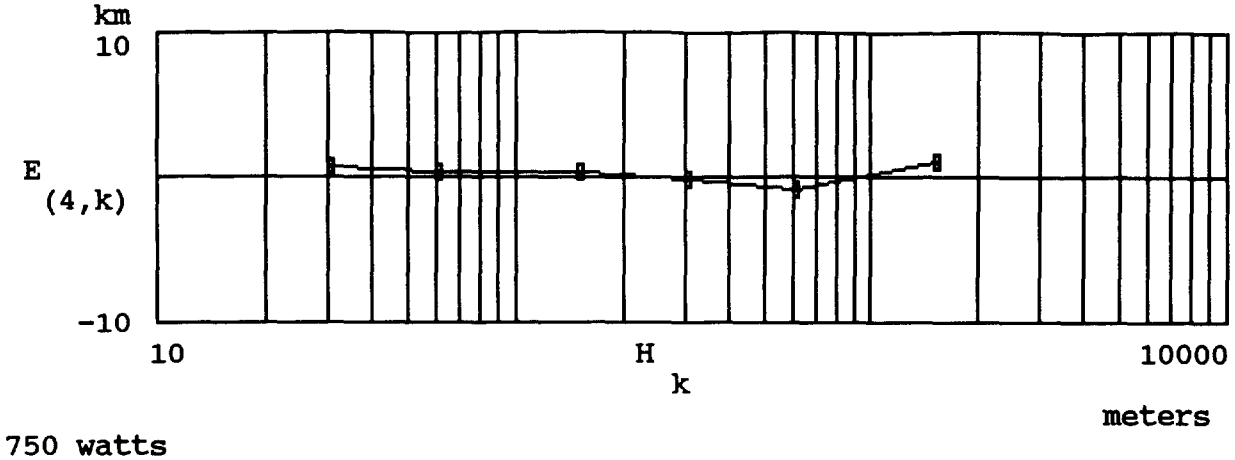
Figure A4. PLOTS of 'Formula Distance' - ' Carey Service Contour Distance' as a function of height for various ERP's



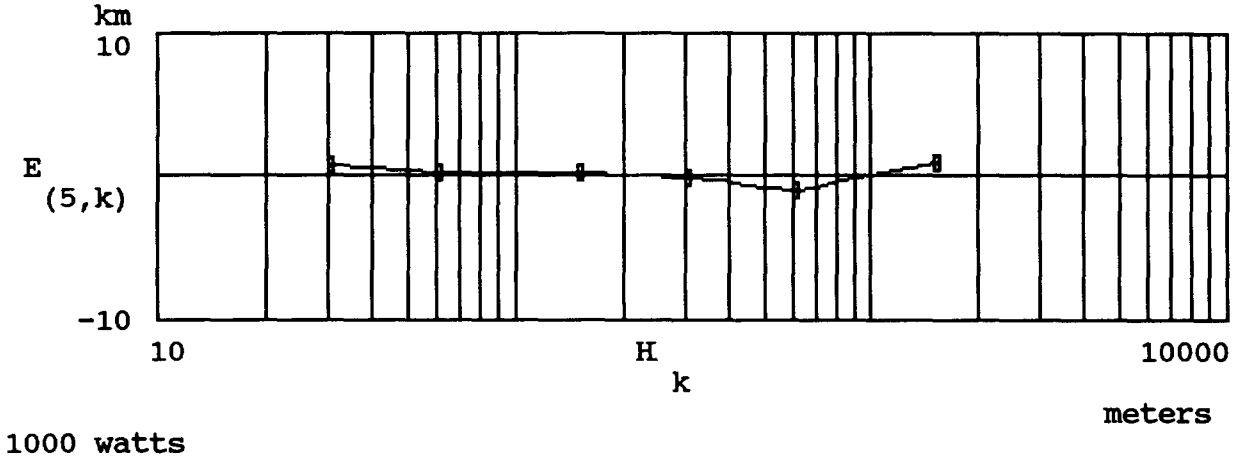




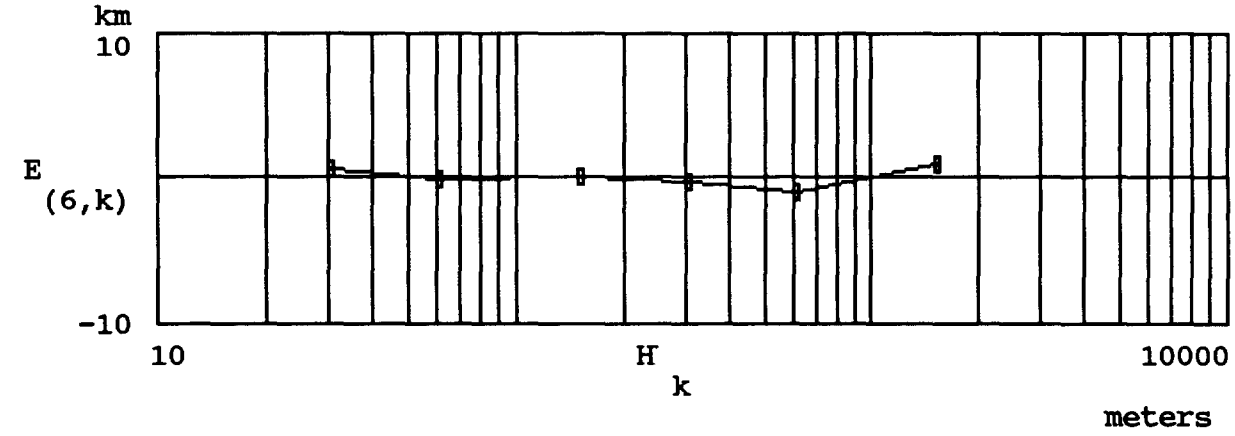
500 watts



750 watts



1000 watts



1400 watts

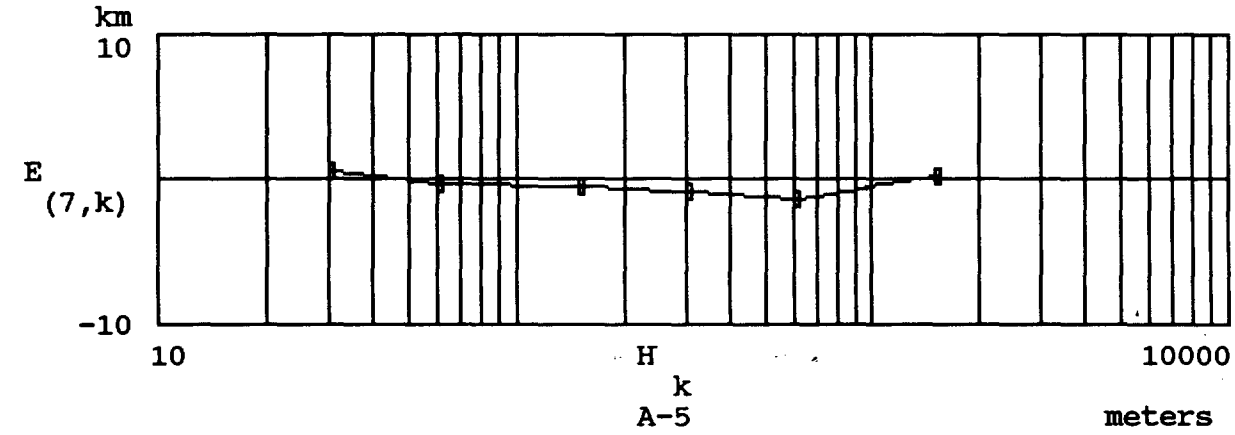


Figure A5. Basic VHF Paging Service Contour Data

Elevations Used: 100, 200, 500, 1000, 2000, 5000 ft.
30.5, 61.0, 152.4, 304.8, 609.6, 1524 meters

ERP's Used: 50, 100, 250, 500, 750, 1000, 1400 watts

Matrix of Carey 43 dBu Service Contour Distances (km):

Elevation⟶

$$VS = \begin{bmatrix} 10.3 & 13.679 & 20.6 & 26.876 & 35.406 & 46.349 \\ 11.909 & 15.933 & 23.496 & 30.899 & 40.234 & 51.821 \\ 14.645 & 19.473 & 28.164 & 36.854 & 47.798 & 59.385 \\ 16.898 & 22.692 & 32.187 & 41.843 & 53.43 & 65.339 \\ 18.347 & 24.623 & 34.762 & 44.901 & 56.971 & 69.202 \\ 19.473 & 26.232 & 36.693 & 47.154 & 59.385 & 71.777 \\ 20.761 & 27.842 & 39.107 & 49.89 & 62.443 & 74.835 \end{bmatrix}$$

ERP ↓

Error Matrix for points in above matrix:
'Formula calculated distance' - 'Carey Service Contour Distance' (km):

$$E = \begin{bmatrix} 0.863 & 0.937 & 0.185 & 0.064 & -0.927 & -0.569 \\ 0.951 & 0.894 & 0.389 & -0.019 & -0.902 & -0.318 \\ 0.822 & 0.734 & 0.436 & -0.021 & -1.205 & 0.475 \\ 0.816 & 0.405 & 0.393 & -0.042 & -0.87 & 1.15 \\ 0.77 & 0.259 & 0.239 & -0.12 & -0.896 & 1.035 \\ 0.663 & -0.068 & 0.018 & -0.3 & -0.913 & 0.909 \\ 0.568 & -0.201 & -0.473 & -0.754 & -1.403 & 0.306 \end{bmatrix}$$

A row by row plot of these errors is presented in Fig. A4.

Standard Deviation of Above Errors: $\sigma = 4.447$ km

Error Matrix -- FCC Proposed Equation:
'FCC equation distance' - 'Carey Service Contour Distance' (km):

$$EFCC = \begin{bmatrix} 0.128 & 0.08 & -0.748 & -0.682 & -0.842 & 3.515 \\ 0.153 & -0.017 & -0.535 & -0.601 & -0.255 & 5.857 \\ -0.024 & -0.18 & -0.33 & -0.127 & 0.664 & 10.531 \\ 0.014 & -0.376 & 0.008 & 0.639 & 2.625 & 15.531 \\ 0.069 & -0.324 & 0.295 & 1.357 & 4.066 & 18.857 \\ 0.089 & -0.42 & 0.547 & 1.985 & 5.454 & 21.766 \\ 0.234 & -0.139 & 0.859 & 2.846 & 7.143 & 25.557 \end{bmatrix}$$

Standard Deviation of errors for FCC Proposed Equation:

$\sigma FCC = 44.771$ km

Figure A6. Proposed VHF Paging Interference Formula.

The following formula has been developed for calculating VHF Paging Interference Contour Distances:

$$d = 7.166 \times h^{.267} \times p^{(.164 - .0000049 \times h)} \qquad h < 150 \text{ meters}$$

$$d = 5.95 \times h^{.304} \times p^{(.164 - .0000049 \times h)} \qquad h \geq 150 \text{ meters}$$

where
d is the radial distance in kilometers
h is the radial antenna HAAT in meters
p is the radial ERP in watts

Figure A7 contains a series of plots of the proposed formula.

Figure A8 contains a series of plots of the Carey Interference Contour (without the 3 dB/Octave height correction).

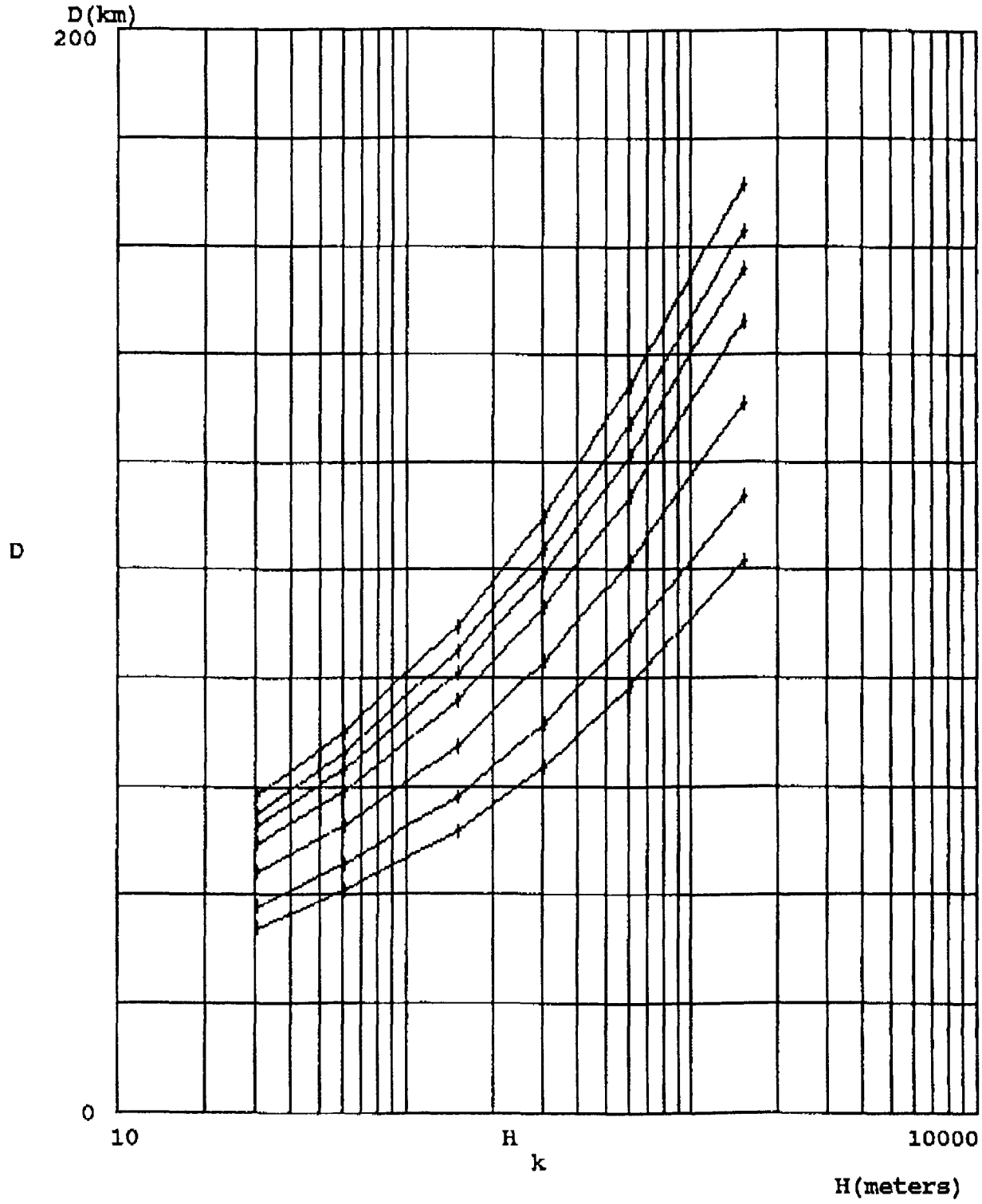
Figure A9 contains a series of plots of the differences between the proposed formula results and the Carey Interference Contour for heights up to 500'.

Figure A10 contains a series of plots of the proposed formula; also shown are the points for both the Carey Interference Contour with and without the 3 dB/Octave Height Correction.

Figure A11 contains listings of the Carey Interference Contour data, errors, and relevant results. Errors for the FCC Proposed equation are also listed. The equation used for these calculations was:

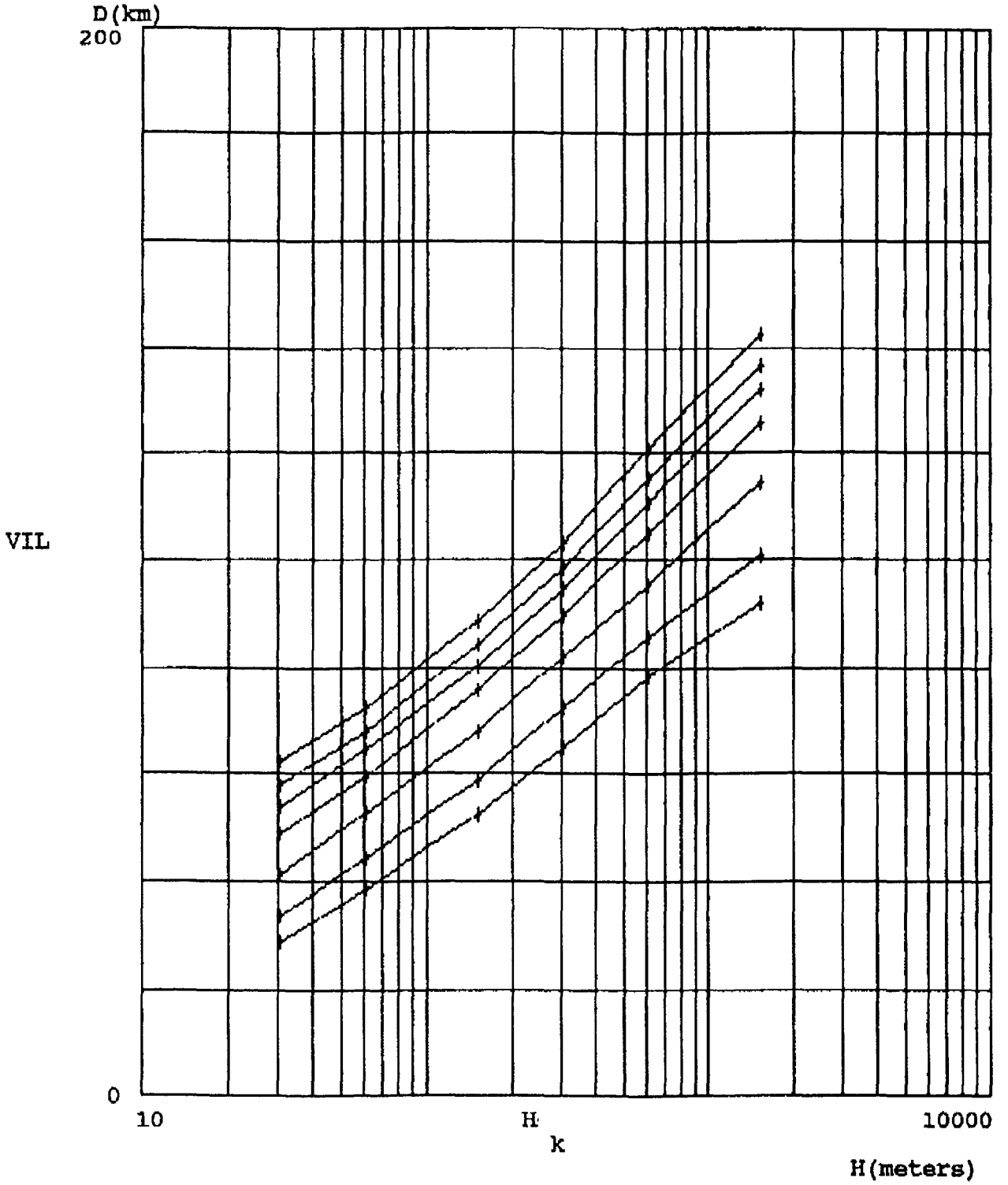
$$d = 6.509 \times h^{0.28} \times p^{0.17}$$

Figure A7. VHF PAGING INTERFERENCE CONTOUR DISTANCE



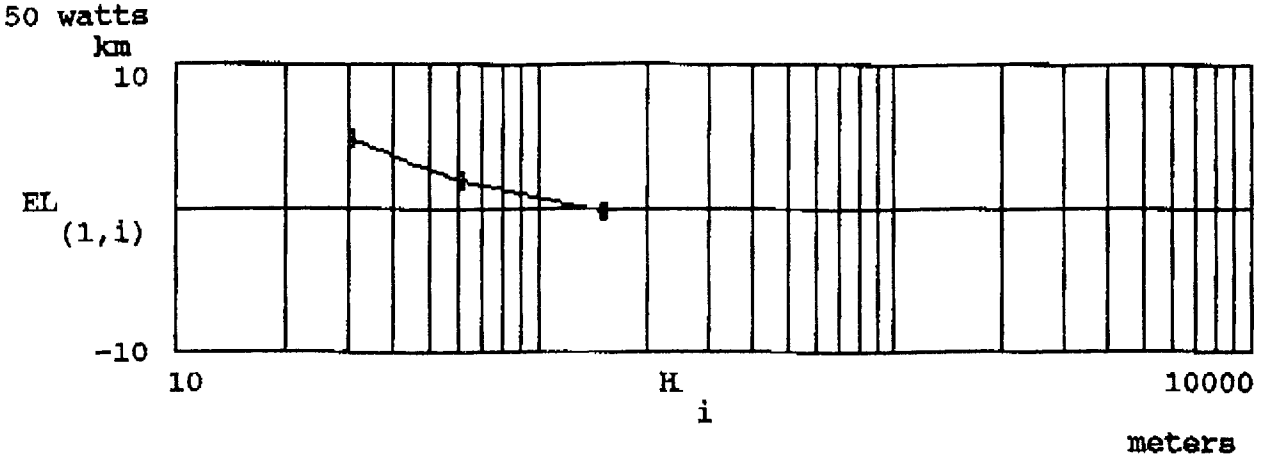
VHF Paging Interference Contour Distances as calculated from proposed formula as a function of Height for ERP's of 50, 100, 250, 500, 750, 1000, 1400 watts.

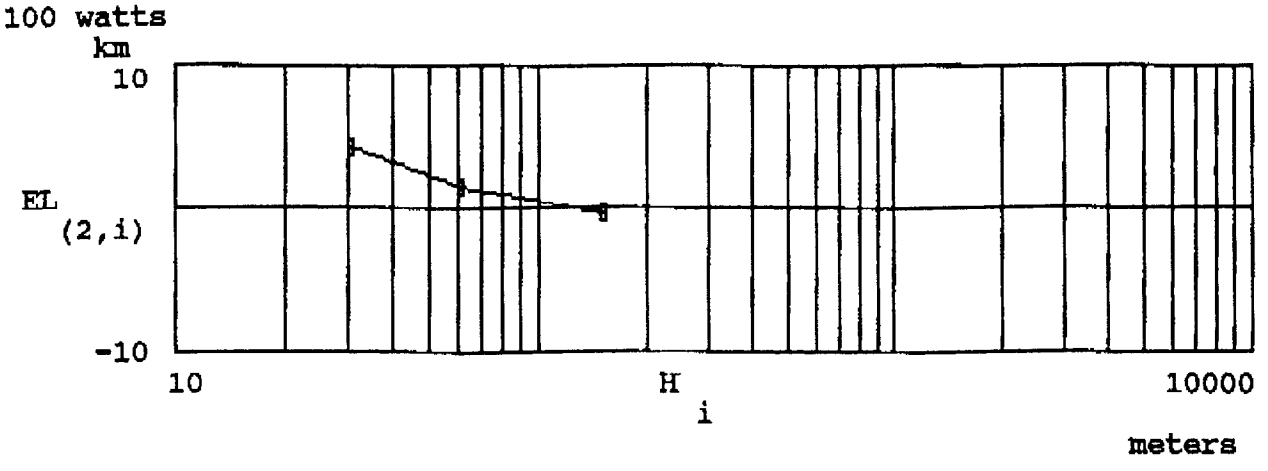
Figure A-8. VHF CAREY INTERFERENCE SERVICE CONTOUR DISTANCES

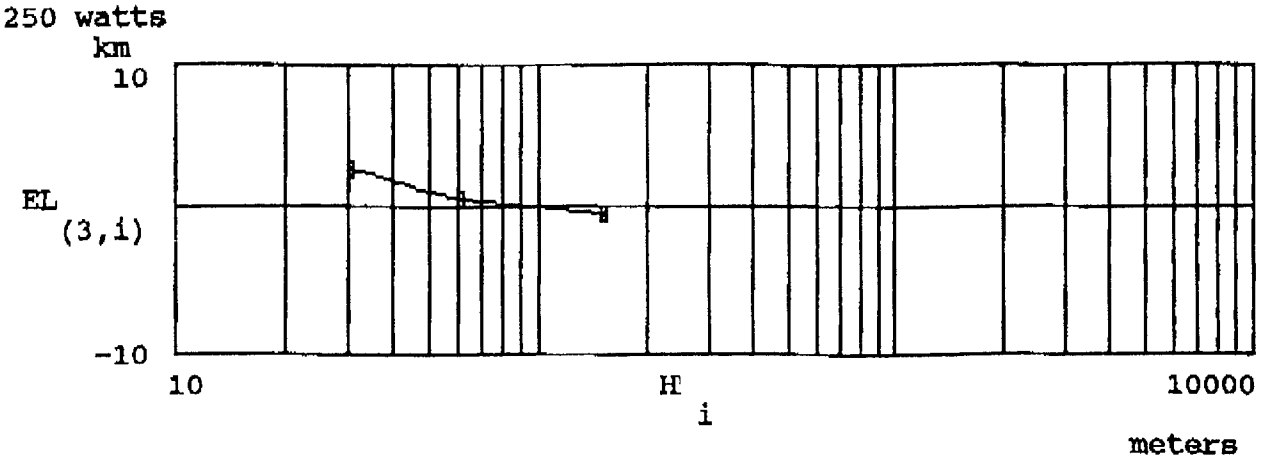


VHF Paging Carey Interference Contour Distances (without additional 3 dB/octave height correction above 500') as a function of Height for ERP's of 50, 100, 250, 500, 750, 1000, 1400 watts

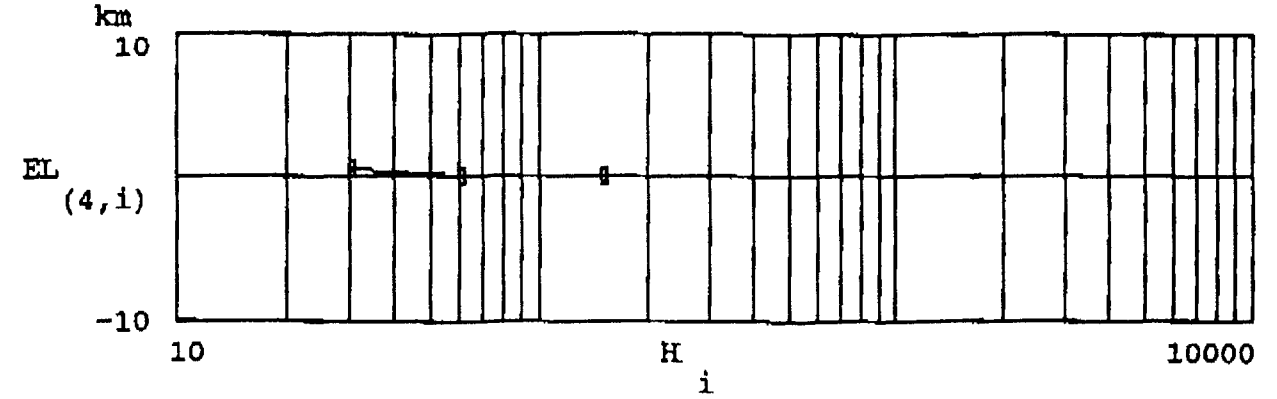
Figure A9. PLOTS of 'Formula Distance' - 'Carey Interf. Contour Distance' as a function of height up to 500' for various ERP's.



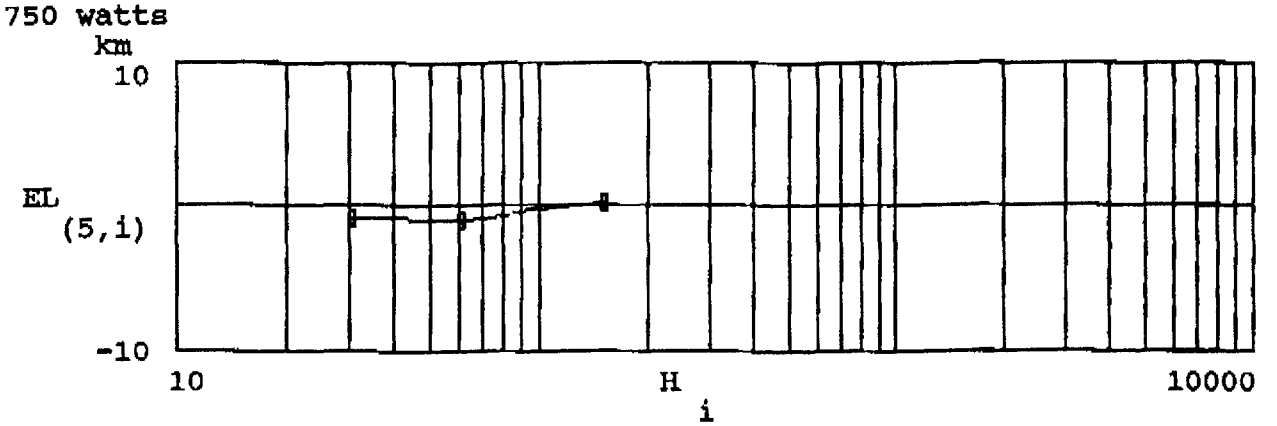




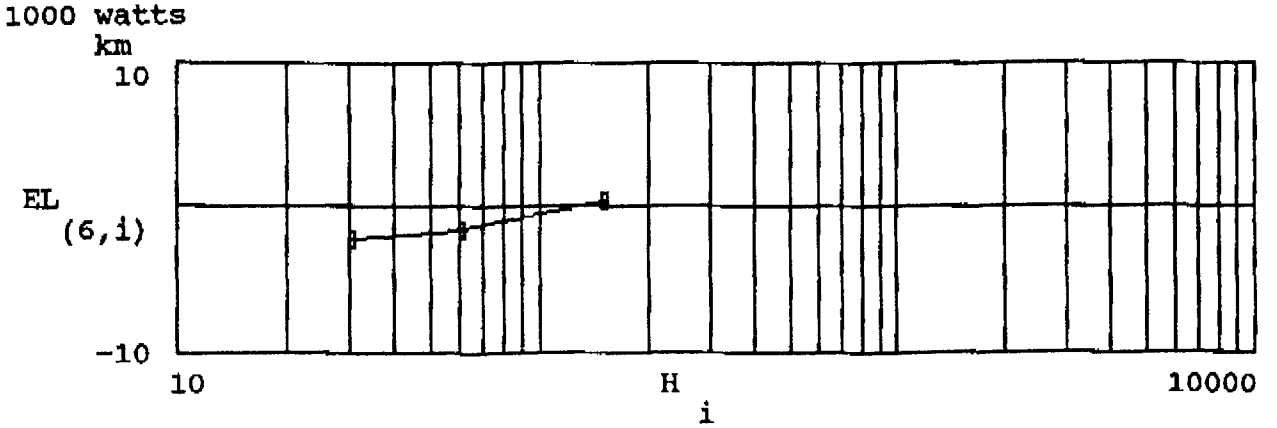
500 watts



750 watts



1000 watts



1400 watts

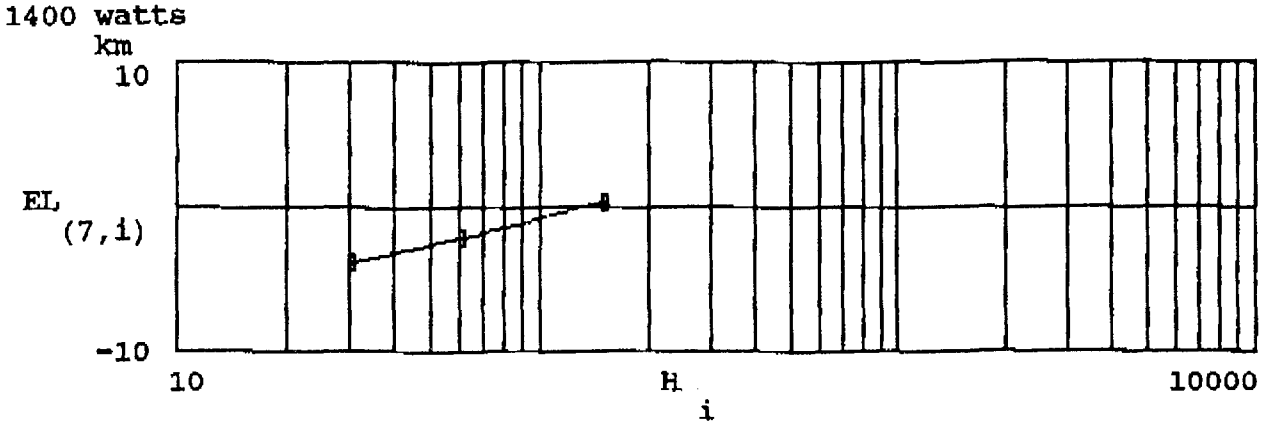


Figure A10(a). Plot of VHF Paging Distance from formula;
x => Carey Interf. Values without height correction;
+ => Carey Interf. Values with 3 dB/Octave height correction.

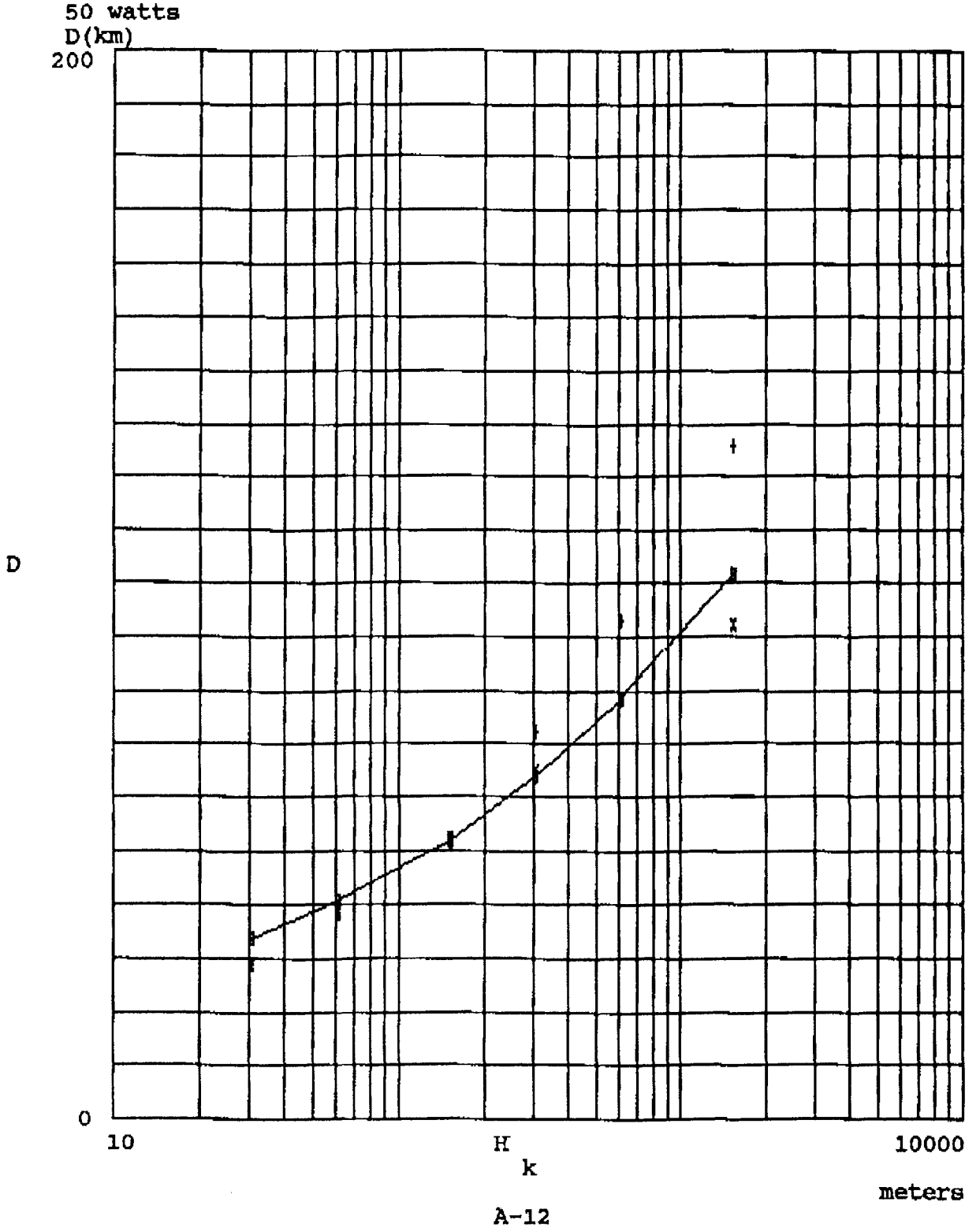


Figure A10(b). Plot of VHF Paging Distance from formula;
x => Carey Interf. Values without height correction;
+ => Carey Interf. Values with 3 dB/Octave height correction.